POLITICAS ECONOMICAS Y PRODUCTIVIDAD

REPORT NO.: HO-TA-01-012

Follow-on Technical Assistance to Cashew Producers in Choluteca & Danlí

Contract Number: 522-C-00-00-00203-00
Sometido a: U.S. Agency for International Development/Honduras
Prepared by: Mr. Ian Duncan

Tegucigalpa, March 2001

The PEP Project is a USAID initiative carried out by Chemonics International Inc. with the participation of the following national and international institutions: Management Systems International (MSI), J.E. Austin and Associates (JAA), International Management and Communications Corporation (IMCC), and the Fundacion para la Inversión y el Desarrollo de las Exportaciones (FIDE).

Project:	Honduras Policy Enhancement and Productivity Project (PEP)
Report Title:	***Follow-on Technical Assistance to Cashew Producers in Choluteca & Danlí***
Contract No.	*522-C-00-00-00203-00*

Project:	**522-0410 (REACT)**
Responds to:	**Special Objective, Intermediate Result 1 – Economic Activity Reactivated**
Submitted by:	**PEP Project Chemonics International Inc., Edificio PALIC, Tercer Piso,Avenida República de Chile, Colonia Palmira, Tegucigalpa, Honduras**
Telephone:	**504-239-3439, 220-5562 Fax: 504-239-4188**
Contact:	**Julio Paz, Chief of Party – PEP Project**
E-Mail address:	**jpaz@proyectopep.com**

TABLE OF CONTENTS

SECTION I

Background

A. Previous Involvement

During October 2000, the consultant visited Honduras on behalf of the Policy Enhancement & Productivity Project (PEP) on a mission that had two objectives:

1. **Review the processing operations of the Union Nacional de Campesinos (UNC), La Sureñita, and Mario Argental; make recommendations on improvements; and also provide information about the world market for the benefit of the three processors.**

2. **Examine environmental conditions in the vicinity of Danlí to determine the suitability of growing cashew in the region.**

In his report, the consultant made the following observations:

1. **Recommendations were made on ways to improve operations at different stages of the processing system. Some of these recommendations required capital investment, and it remained the decision of the processor to determine his priorities on the financial cost and benefits received.**

2. **The consultant provided market information and market contacts in the major US and European markets to assist the processors in potential future sales. The processors already are aware of the local market conditions and opportunities.**

3. **Information was provided on the organic cashew market so that processors could determine the costs and benefits of entering this market.**

4. **A preliminary conclusion was reached that areas of the Danlí region were suitable for cashew production, provided the areas selected were (1) higher rainfall areas, and (2) high altitude country was avoided because of the lower temperatures. Suitable soils were initially observed, however, no soil analysis was possible due to a lack of digging equipment (barreno). The soil analysis was to be completed after the consultant's departure.**

B. Assignment Objectives

The majority of the cashew trees in the world were planted from unselected seed, and as cashew is a cross-pollinated crop the performance from these trees will be variable, but mostly poor. This (on average) poor performance by most of the world's plantings is also due to a lack of inputs where total yield of a cashew tree is mainly input related (nutrients, pest control), but also partly due to genetic characteristics. On the other hand, the

important characteristics of nut quality, tree shape, and timing of harvest are strongly influenced by genetics. Therefore it requires both good genetic material and inputs to achieve maximum performance.

In Choluteca, Honduras all the plantings to date were made from unselected seed and the growers to date have made virtually no use of inputs. During October/November 2000, a FINTRAC consultant from Brazil undertook an assignment to assist the growers in Choluteca regarding the management of the crops, including the use of inputs.

PEP concluded that the lack of superior genetic material remained a major constraint to the improvement of cashew production in Choluteca and also would be a constraint to the development of a new industry based on the most productive lines in Danlí.

The consultant was engaged in this current assignment to:

1. **Import selected cashew seed from Australia to form a new gene pool in both Choluteca and Danlí. A total of 25 kg of seed (about 3,250) was imported into Honduras, 15 kg for Choluteca and 10 kg for Danlí.**

2. Develop a program for the effective utilization of this seed for the longer-term genetic improvement and its use in commercial production, both in Choluteca and Danlí.

SECTION II

Fieldwork in Choluteca and Danlí

A. Field work undertaken in Choluteca

The consultant presented a two-hour seminar to the three interested parties in Choluteca, UNC, La Sureñita and Mario Argental. This seminar covered topics including, (1) conditions for growing cashew, (2) methods used in the nursery propagation, (3) importance of genetic selection and (4) discussed a development plan for the effective utilization of the imported seed.

Following the seminar the consultant dispersed the 15 kg of seed to the three parties (nominally 5 kg each), and it was understood that the three parties would collaborate in the nursery, planting and selection phases in the utilization of the seed. The consultant was unable to view any nursery operations as he was advised by UNC that there was nothing to see in terms of physical facilities at this stage.

The consultant was given the impression that the three parties were comfortable with the technical requirements of propagating cashew and did not require any specific further input from the consultant apart from what was discussed during the seminar.

B. Field Work undertaken in Danlí

The consultant inspected the facilities of the municipal nursery in Danlí, which was previously selected for the propagation of the seed. A few deficiencies were found that needed immediate correction.

> **50 % shade cloth- trees should be held under 50 % shade for about first 8 weeks, i.e. until they are minimum of 25 cm tall and they have sufficient foliage to shade the soil in the planting bag.**
>
> **NPK slow release - needs to be applied with planted seed. Some has been purchased by PEP, however in Danlí, more NPK slow release is required.**
>
> **NPK/micro nutrients - nursery has none. This must be applied as foliar spray once every two weeks.**
>
> **Insecticide- nursery has none; use depends on need, but likely once every three weeks.**

The nursery has three workers who would be quite adequate to undertake these required tasks.

The consultant supervised the planting of the first batch of seed. Following an explanation of the techniques required, he was confidant that the workers were sufficiently knowledgeable to follow what was required, including a minimum of daily watering.

The consultant also undertook a seminar in cashew for interested parties in Danlí. This seminar covered (1) conditions for production of cashew, (2) importance of genetic characteristics in cashew, (3) a program for the use of the imported seed in the development of gene pool and its' subsequent commercial use, and (4) technical aspects of operations in the nursery.

During the seminar, the issue of where the trees propagated from the seed would be planted was discussed; these selected people would manage the plantings for the future benefit of the industry in Danlí on terms still to be finalized. It was not material whether the new trees were planted in one site or at two or three sites as long as the environmental conditions and the management are similar.

SECTION III

Genetic Selection and Program of Development

A. Genetic Characteristics

The following criteria are important in selecting a good variety of cashew.

- Total yield**- no absolute figure, apart from selecting those trees that give in the top 10% of those under selection.**
- Nut quality is in two parts
- Kernel size**- larger kernels fetch higher prices. The most common grade in the market is W320 grade (320 whole kernels/lb). Prices for kernels of the larger grade W240 may have a 5% to 10% premium, while W210 grade may be 15% to 20% above W 320 prices.**
- Recovery %**- this is % of kernel to whole nut. The possible range is 20% to near 40%. Crop at 40% recovery represents double the yield of crop at 20% recovery in terms of final product (kernel). Usually there is an inverse relationship between nut size and recovery %, as nut size gets larger, recovery % is reduced.**
- Tree shape**- cashew only produce fruit on the canopy surface, and therefore a natural dense canopy gives a greater potential for cropping. In addition, a compact and upright tree shape allows for higher density plantings, and hence higher yields per hectare.**
- Time of bearing **- some cashew types are naturally early bearing, and this produces bearing fruit earlier in the season. Early bearing trees avoid potential problems with harvest during the wet season and they may also save costs with a shorter period of crop management required**

The objective of genetic selection is to pick those trees, which have the best balance of characteristics in order to maximize the value of product (kernel) from a tree. This may involve a compromise between the characteristics as presented below.

	Tree A	**Tree B**
total crop	**10 kg**	**9 kg**
size of nut	**10 gm**	**6.5 gm**
% recovery	**24 %**	**32 %**

size of kernel	**W 180 grade**	**W 240 grade**
price/lb	**US$ 3.20**	**US$ 2.80**
Value of crop/tree	**US$ 7.68**	**US$ 8.06**

The above example shows that Tree A despite having a higher total crop and larger nut size, is actually "less valuable" than Tree B.

The seed imported from Australia is from an elite group of about 100 trees that were selected from a large number of seedling trees over the past 12 years. The minimum criteria for this selection was the following:

1. **W320 grade or larger in kernel size. W 320 grade is the most commonly used grade, and the selection includes larger grades up to W 180 which is the largest grade normally marketed.**

2. **Minimum of 30% recovery. Range of seed is 30% to 38%**

3. **Compact and upright tree shape.**

The criteria of maximum total yield were also used, but a specific cut off figure was applied as this characteristic is highly influenced by inputs (irrigation and nutrition), and management. Some consideration was also given to time of bearing but to a lesser degree than the three criteria indicated above.

B. Program of Selection

The overall objective is to select the best cashew trees grown from the imported seed according to the characteristics discussed in section A, and then produce large numbers of these trees for commercial use. While there are benefits in the short term by growing the imported seed, the maximum benefits only come in the long term when virtually unlimited numbers of the new 'superior trees' can be available for commercial use.

There are four stages to the proposed development program as follows:

1. **Seed propagated in nursery.**

2. **Seedling trees are planted in plantation, so performance can be monitored for a minimum of three 'commercial harvests' (years 3 – 5).**

3. **Grafting of the selected superior trees produces replicates, and these trees are also planted in plantation as a future source of scions (yemas). A target of 30 to 40 replicates of each selected tree is suggested. The number possible will depend on the**

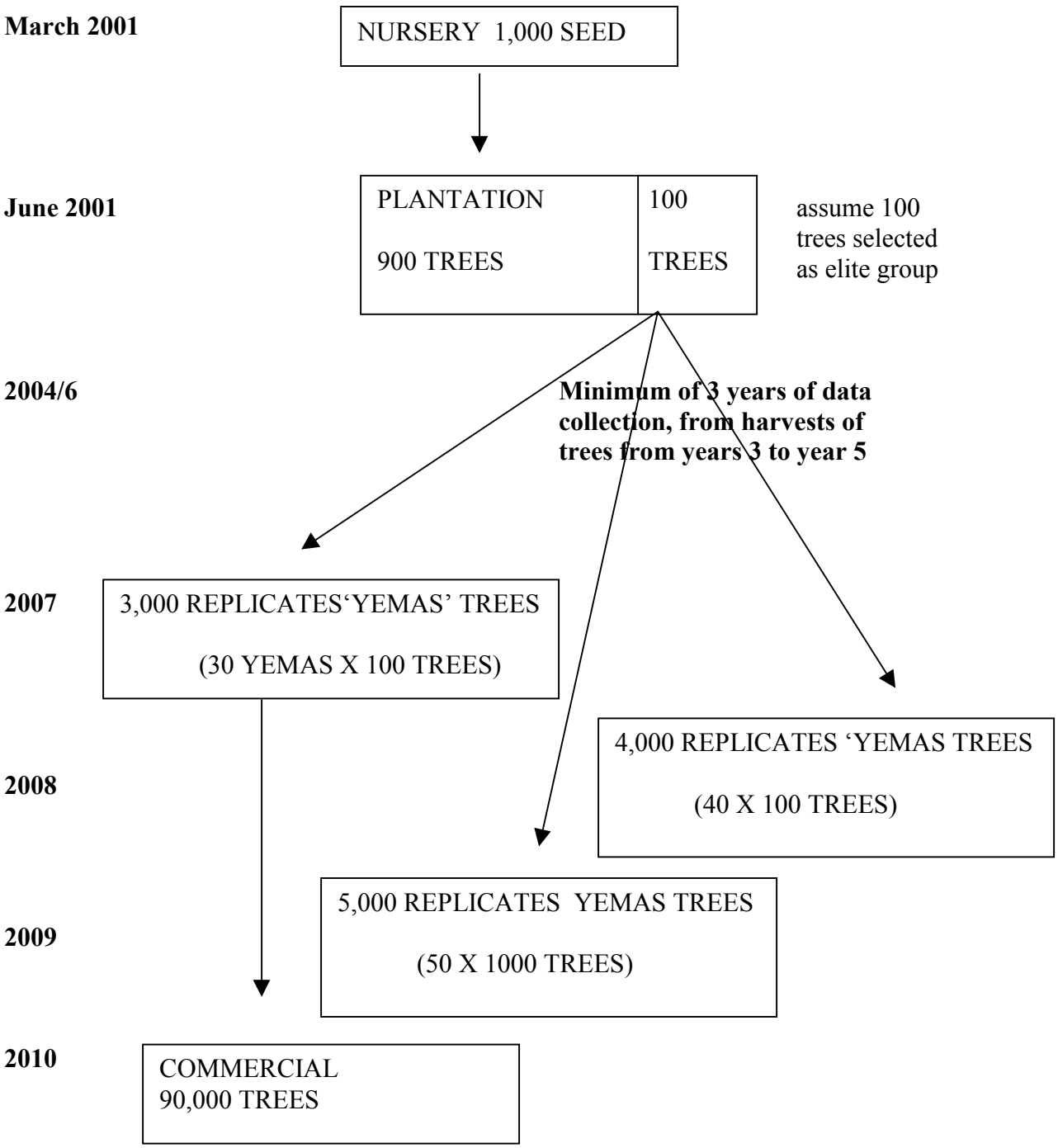
volume of canopy of each selected tree. The process of producing more replicates can be continued from the same selected trees in the following years.

4. **Large-scale production of trees of selected varieties is made using both the original selected mother tree and most importantly the yemas trees.**

It is recommended that both Choluteca and Danlí follow the genetic selection program outlined on the next page. This timetable for development will be similar for both Choluteca and Danlí. It must be noted that as there are differences in the environmental conditions of Choluteca and Danlí, each site may select varieties most suited to their own particular conditions.

C. Timetable for Development

Example used is for Danlí, Choluteca program is identical.



In 2011, there will be about 240,000 new trees available, and 460,000 new trees available in 2012.

At Choluteca, it is unclear to what extent the three parties (UNC, Surenita, and Argental) wish to cooperate with the development of the introduced seed. The consultant recommends that the three parties be encouraged by PEP to observe the following.

1. Utilize a common nursery for the propagation of the seed.

2. Agree on a common system for monitoring and data collection on the new trees planted (presumably each party will give/sell these new trees to their own growers).

3. Agree to exchange (sell) grafted trees produced from the proposed development program to new growers to benefit the overall industry in Choluteca.

D. How to Collect Data for the Selection Program

All trees in the plantation should have a unique number for identification. An easy system is to assign (1) a row number and (2) a tree number. In the first two years, all trees are observed for performance, and if possible the trees, which appear to have the most potential, should be identified prior to the 3rd year harvest. However the grower can add or subtract from this list based on his observation of the potential of the 3rd year harvest.

The grower should spread the net quite wide at this stage. For example, if there are 1,000 seedlings under trial, then at least the best 100 should be selected. If resources are limited, then the best 50 should be chosen.

The steps of data collection for the above 100 selected trees is as follows.

1. The crop from all of the 100 trees should be isolated so that an accurate measure can be made of the total yield. On conclusion of the harvest, the apple is removed and the total nut crop is weighed and recorded. Apart from the requirements of further sampling the crop may be used for commercial purposes.

2. Trees should be assessed for both dense canopy and upright growth habit. This is a qualitative assessment, and trees can be assessed as having (1) good, (2) medium, or (3) less favorable levels of above characteristics.

3. A sample of 30 nuts from each tree should be removed for nut quality analysis and the following steps taken to make the assessment for both kernel sizes.

   (a) Soak nuts in water for ¾ days to soften shells.

   (b) Cut through shell (wearing gloves as protection against CNSL).

   (c) Remove kernel with testa attached.

(d) Dry kernel with testa at 65 degree C for 4 days.

(e) Weigh kernel with testa (KT) and adjust weight at 5% moisture using formula (KT – (KT x 0.066] x 1.055. (In this example a 1.55 gm kernel including testa will translate into a W320 grade 1.44 gm kernel at 5% moisture).

1. For analysis of recovery rate the following steps are undertaken with the same 30 nut sample as above.

(f) Weight 30 nuts (total weight) before soaking as required above (in the absence of specific data, it can be assumed that raw crop after harvest in Choluteca climate will be at 10% moisture level).

(g) Take kernel weight of 30 kernels from (e) above and express as % of total weight of (f).

It should be noted that the analysis for recovery rate and kernel size requires professional input and use of some equipment. It may be more appropriate for some growers to contract the collection of this data to a suitable institution.

Following the collection of data on 3rd year harvest, it may be appropriate to reduce the number of selections to a reduced elite group, to perhaps 50% of the original selections. This reduced group should be evaluated in similar fashion in years 4 and 5.

It is also advisable that growers make an early estimate as to which trees might be their final selections. In this case, the grafting of one or two replicates of these selections will significantly reduce the time required for large-scale multiplication later on. It is important not to take more than a couple of scions (yemas) off each tree so as not to jeopardize future cropping of this tree (which is still under evaluation).

SECTION IV

Technical Details - Nursery

A. Nursery Infrastructure

The nursery should be located on level ground, and in sheltered position (away from strong wind). It must be located close to a source of water. In addition, there should be a sufficient sheltered area adjacent to the nursery to allow the young trees to be held for two weeks in full sunlight prior to planting in the field.

It is important to have sufficient area in the nursery for both (1) holding trees and (2) for working space. With two liter planting bags of 10 cm diameter, there are 100 bags /sq meter. Allowing for 60% working space, this requires a nursery area of 250 square meters or 16 by 16 meters to propagate 10,000 seed.

The following items are required for the nursery operation.

- Shade cloth (50% sun penetration) for roof, direct contact of sun on seedlings must be avoided, so walls of shade cloth may also be necessary, approximately one meter of shade hanging from roof.

- Water supply, either overhead sprinkler system, or hose that allows application of water by hand.

- **Planting bags of poly material, size 2 litre, of dimensions 10 cm and height 25 cm.**

- Growing medium, a suitable mixture is 50 % coarse sand and 50 % sandy loam soil.

- Slow release fertilizer (NPK) in granule form.

- Foliar fertilizer (NPK + micro- nutrients).

- Elements for possible nutrient disorders, (iron chelate and zinc heptahydrate).

- Insecticide, dimethoate (40% active), together with backpack spray and protective clothing.

B. Preparation

1. The planting bags must be filled with the growing medium, and a small amount of slow release fertilizer is added. The planting bags can be placed in groups of 100 in the nursery.

2. The cashew seed is sown in the planting bag, 1 cm to 2 cm below the surface of the soil. The seed should be positioned with the curve of the seed facing upwards.

   (Note, when using seed of unknown quality, it is recommended to undertake a float test on the seed prior to planting. The float test involves putting the seed in a shallow tank of water to determine whether the seed contains developed kernel or not. Those seed that float should be discarded, while those that sink can be used for planting).

3. The seed will usually take about 15 to 20 days to geminate

C. Nursery Operation

1. The planted seed should be monitored on a daily basis for any signs of abnormalities (insect attack, nutritional deficiency, etc).

2. Water should be applied on regular basis; twice a day may be appropriate in hot humid conditions.

3. An application of NPK foliar nutrition containing micronutrients should be commenced once the young seedlings are about 10 cm in height, this application should be repeated every two weeks while seedlings are in the nursery. The foliar application should be used with a wetting agent to improve the uptake of the nutrients by the seedling.

4. Any weeds found growing in the pots should be removed by hand.

The objective is to grow the seedlings to a sufficient level of maturity inside the nursery to allow them to be moved outside into full sun for a 'hardening off' or acclimatization process. The seedlings are ready to move from 'under shade' into full sun, in a position just outside the shaded area when the following situation applies:

- the seedlings appear healthy

- they have grown to a height of minimum 25 cm, and up to acceptable 30 cm

- the plant has sufficient foliage so that it shades the soil in the bag (it is important that the soil in the bag does not become too hot).

The time taken for the seedlings to grow to 30 cm will depend on the conditions, however in normal circumstances this could be from 8 to 10 weeks.

The move into 'full sun' is to allow the seedlings to grow further while fully acclimatizing to the weather conditions in the field prior to planting. The time spent in the 'hardening off' phase will depend on what conditions are likely to be experienced in the field, For example,

1. If conditions in the plantation are expected to be good, i.e. favorable weather conditions, well prepared planting holes, no weed competition, good management in the field, then the trees could be transplanted when the have attained a height of about 35 to 40 cm, after about 2 to 4 weeks in the 'hardening off ' phase.

2. If conditions in the plantation are expected to be poor**,** i.e. less favorable weather conditions, weeds, less well prepared planting holes, possible less attentive management, then the trees should be grown to a larger size, i.e. at least 45 cm before transplanting. In this situation the trees may be held in the 'hardening off' phase for 4 to 6 weeks.

It is necessary to guard against holding the trees in the nursery (and remaining in the bags) for too long a period, or the root system will become 'pot bound'. This is a condition where the root system has outgrown the area available in the bag, and probably will occur if the trees remain in the bag at 6 months of age.

Nutritional deficiencies and insect pest damage are two likely problem areas with the seedlings in the nursery. These potential problems are described in the following paragraphs.

D. Nutritional Deficiencies in the Nursery

The best defense against nutritional deficiencies is to apply a foliar spray containing micronutrients as indicated in the previous section. However if deficiencies are to occur the most likely are of (1) iron, and (2) zinc.

Iron Chlorosis

Deficiency of iron can cause high mortality in young seedlings. In the early stages of the deficiency, the seedlings growth will be affected. Later visible symptoms, perhaps after 4 weeks, appear when the whole leaf except the leaf midrib turns yellow. After 8 to 10 weeks, black spots will be seen on the leaves, and these spots may give the appearance of a fungal attack.

The recommendation is to take a proactive approach and not wait for any symptoms to appear; because by the time symptoms are evident significant damage has been caused. At six weeks of age, apply a mixture of one teaspoon of iron chelate to 10 liters of water. This mixture is probably best made up in watering cans and applied as a drench on the seedlings. One application of iron chelate will very likely be sufficient to eliminate any chance of a problem.

Zinc chlorosis

Symptoms of this deficiency are reduced leaf size and subsequent poor growth of the seedling. If symptoms appear, it is necessary to apply an aqueous 0.1 % solution of zinc heptahydrate (or other) to the seedlings. One application is usually sufficient to cure the deficiency and normal leaf size and growth is restored.

E. Pest Damage in the Nursery

There is very limited information on pests of cashew in Central America. *Leptoglossus zonatus* (chinche), and other species are known to be a major pest of cashew in El Salvador, and chinche is known to breed and feed on a range of other crops such as curcubits, maize, sorghum etc. Since chinche is usually associated with attack on developing crop in cashew and it is likely to be an issue with small seedlings in a nursery.

It is estimated that the following insects may be the prime cause of damage in the nursery,

- thrips, especially *Selenotrips rubrocinctus*

- aphids, possibly *Aphis gossipi*

- mites

- caterpillars

Thrips – a more detailed description of thrips is given in the plantation section, however in general thrips are very small sap sucking insects that concentrate their activities on the underside of the leaf. Their main impact is to remove fluids from the seedling and hence they reduce the health of the plant, and in severe cases this could cause death in young plants.

Aphids and **mites** are also small insects that feed by sucking sap and having a debilitating affect on the seedling. Mites will be found on the underside of the leaf. **Caterpillars** are leaf feeders and from second instar to adult status can destroy significant quantities of leaf tissue. The recommended solution is for a careful daily monitoring of the seedlings in the nursery to be undertaken by a person to evaluate the insect status of the trees. If this level of monitoring is possible then the timing of remedies can be left to when a pest threshold has been reached. However if expert monitoring is not possible then it is recommended to undertake a regular program of prophylactic sprays to maintain control.

The recommended approach is

- remove all caterpillars found on the leaves by hand. Their numbers and presence are likely to be low.

- spray with dimethoate (40% active) at ratio of 1: 1,500 every 3 weeks. (this chemical requires operator to use protective clothing. Note, alternative chemical can be used depending on local availability.

F. Grafting

Grafting is the most practical method of vegetative reproduction to produce clonal trees. Grafting involves the use of vegetative material or scions cut from the selected mother tree, and these are

then 'grafted' on to the recipient rootstock. There are a number of techniques of grafting in common use, two of the techniques in common use are side grafting and wedge grafting**.**

The stages involved in wedge grafting are as follows,

(a) rootstock should be grown to 20 to 25 cm in height (6-8 weeks).

(b) scions cut from mother tree, scions should be (1) as long as possible in length and (2) free of and insect damage or disease. After cutting, scions should be placed in wet paper bags and kept cool. (scions have a short shelf live of perhaps 36 to 48 hours even in best of conditions, so should be grafted onto rootstock immediately).

(c) rootstock to be decapitated about 60% up stem, making sure that some leaf foliage remains on lower stem.

(d) wedge is cut into top of decapitated rootstock stem, and corresponding wedge is cut on end of scion to ensure firm joint. (important that all cuts are with firm strokes with no ragged edges)

(e) scion is joined to rootstock and union is made firm with tape or strong pegs. A plastic bag is put over top of graft union.

(f) If humidity conditions are not sufficiently high, success in grafting can be improved by placing grafted tree in a enclosed plastic 'sweat tent'.

(g) grafted tree has plastic bag above graft union removed when two new leaves have grown on new graft (2/3 weeks). Grafted tree can be removed from plastic sweat tent when a further 2/3 leaves have grown (four weeks).

(h) grafted trees removed from sweat tent are placed in 50% shade for two weeks before being placed in full sunlight to 'harden off' prior to planting in the field.

The total period from grafting to planting clonal tree in the field will depend on many factors but is frequently about 12 weeks.

SECTION V

Technical Details - Plantation

A. Plantation Design

The following points are relevant.

1. Select area that has correct environmental conditions. Rainfall and temperatures are suitable throughout Choluteca district and in parts of Danlí district, so need to confirm that soils are deep, (1.5 meters) of free draining soils, and pH of 5.5 to 7.0 It is preferred that soil structure analysis is undertaken of (1) sand, silt, clay %, and (2) pH to confirm suitability of soil structure before any significant plantings are made.

   The ideal soil structure is more than 80% sand and pH of 6.0 to 6.5. Soils with less than 60% sand would be much less suitable. PHs of below 5.0 or above 7.5 are not suitable, however these can be remedied at a cost by applying special fertilizers.

2. Selected area should be level, or less than 10% slope is preferred. If grown on steeper slopes, drains may have to be dug to divert excess water away from plantation.

3. Do not disturb watercourses, leave line of buffer trees to keep them stable, and do not plant trees where water may gather in depressions.

4. If irrigation is used then seek professional advise on design, best locations and sizes of pumps, filtration system and irrigation lines. Experience has shown that drip irrigation system is the most cost efficient method and the system to supply up to minimum of 3ML of water per hectare of cashew trees per year is required.

B. Site Preparation

Clear land of trees and heavy grass, however if possible leave native trees standing on edges of plantation to act as windbreaks. Cashew trees are susceptible to damage from high winds. If strong winds are an issue and native trees are not already planted on site then consideration should be given to planting of windbreak trees.

Fire is a major hazard for cashew, it is important that a 20 meter area around the plantation is cleared and kept free of vegetation as a firebreak.

The rows for the cashew trees must be measured and marked out by placing a peg to show location of tree hole. If site is on a slope then rows should be planted out across the slope.

Tree shape between cashew types can vary significantly, and spacings used can vary from 5 meters up to 10 and 12 meters. The future shape of the trees to be planted from the imported seed

cannot be accurately predicted. However, a significant number of the mother trees have an upright growth habit and the progeny should largely be similar. For the planting in Honduras, consistent spacing must be as concentrated as possible to minimize land use and large enough to accommodate the vast majority of trees to be planted without major pruning efforts.

The recommended spacing to use with these trees is 8 by 7 meters, (8 meters rows and 7 meters between trees). If space is a problem a spacing of 8 by 6 meters would also be acceptable. It should also allow some inter-cropping for the first 2/3 years, until the growing cashew tree canopies close up.

The planting holes should be marked with a peg. They should be dug about 35 cm deep and 15 cm wide. The removed soil should be left beside the whole.

C. Planting of trees

There are a number of important factors relating to condition and timing of planting the cashew trees.

1. Only trees that have sufficient maturity should be planted out in the plantation. Sufficient maturity could be defined, as a healthy plant with a minimum height of 40 cm to 45 cm. assuming reasonable growing conditions in the nursery this level of maturity should be attained in 3 to 4 months. In addition these trees should have good leaf color, be free of pests and diseases, and fully hardened to sunlight before being planted out in the plantation.

2. The following planting procedure should be followed.

   - water pots well one day before planting.

   - do not plant trees at hottest time of day, do it in the morning or evening.

   - place small amount of NPK slow release fertilizer in planting hole and cover with 2 cm of soil.

   - remove tree from bag, examine roots of tree and straighten any extended roots sticking out of bag.

   - cut bottom off poly bag, place remainder in planting hole, cut the side of the bag, slowly slide the bag off without disturbing the roots (disturbance of root system can cause losses).

   - fill in loose soil around tree, and make firm with hands, do not jump with feet to harden soil.

   - if rainfall is deficient in next four weeks, water trees twice a week for four weeks.

When planting cashew trees the position of the tree in the hole is important. The top of the soil in the planting bag is known as the ‘nursery level’. When planting the ‘nursery level’ should be about 10 cm below the level of the ground. However it is important that only 2 cm of fresh soil is laid on top of the ‘nursery level’ of the planting bag, the remaining 8 cm of space will be filled due to erosion over time.

The tree position described above indicates a deep level of planting. The benefits of this approach to planting are as follows.

1. Better stability against wind damage because the lateral roots will radiate from the trunk at a lower level, and less chance that soil erosion will cause instability.

2. Root system is in contact in soil at deeper level where soil moisture levels will be higher and longer lasting.

SECTION VI

Future Management of Industry

To date PEP (along with FINTRAC) has been providing an input into the cashew industry in Honduras. These organizations have provided technical assistance and genetic material.

1. **Technical assistance**. (PEP to both Choluteca and Danlí, FINTRAC to Choluteca)
2. **Genetic material**. PEP has provided imports of selected cashew seed from Australia to both Choluteca and Danlí. It is reported that FINTRAC will provide cashew scions from Brazil to Choluteca.

In both Danlí and Choluteca, the consultant was asked if PEP would provide further assistance to the cashew industry in those areas. In Danlí, this question was more relevant as the industry remains in the embryonic stage and the producers are still very inexperienced in cashew.

It is the consultant's belief that Danlí in particular would benefit from further technical assistance, because of their early stage of development, and they have little or no previous experience with cashew. This assistance could be targeted to help them properly establish the plantation stage with the new trees produced in the nursery, and be fully prepared for the selection and multiplication program that they will undertake in the next few years. There is the danger that without proper direction, the entire effort of the introduction of the new gene pool may be wasted.

Above all the issue requiring consideration is what happens after PEP operations in Honduras wind up at the end of 2003? To date, especially in Danlí, PEP has been the driving force, and experience elsewhere shows that frequently without a 'replacement organization' to take over from the initiating body, the project may slowly collapse.

The preferred solution is that a local 'organic structure' can emerge to give the direction required to a developing industry. In Nicaragua where a new cashew industry is emerging, they face similar problems with the forthcoming closure of ARAP at the end of 2001. The approach here has been for ARAP to encourage the formation of an indigenous industry association to give this management and control function for the future. While still in its early stages ANIMAR (Asociación Nicaraguense de Maranon) already has taken over the management and distribution of new imported genetic material. The plan here is that ANIMAR purchases, and propagates the new material and sells the new trees to growers, and uses the income to finance the gene pool imports and initiate research projects or other issues of value to the industry. This association is owned and operated by its members.

The economics of funding association activities by the import of genetic material and sale of trees to growers is encouraging. In Nicaragua, the cost of importing the seed and propagating the new trees costs a total of about US 0.75 per tree. These trees are sold to growers at US$2.00 per tree. This arrangement is also good for growers, new trees from improved genetic material can more than double earnings (yield, nut quality) compared to planting (presumably free) unselected

seed. If we assume an unselected seedling giving a yield of 5 kg/tree at US$0.80/kg for 30 years (total income US$120), compared with a superior tree giving a yield of 10 kg/tree at $1.00/kg for 30 years (total income US$300). The US$2.00 investment in the new genetic material will give an increase of income of US$170 over 30 years compared to the alternative. It would appear that the creation of an industry association might also be suitable in Honduras. There is the difficulty of the different stages of development in Choluteca and Danlí to consider, whether a Honduras Cashew Association would be totally dominated by Choluteca to the detriment of Danlí. On the positive side the close proximity of Chinandega to Choluteca could see cooperative developments between the organizations in both countries. For example, chinche (*Leptoglossus sp)* damage is the major problem of the cashew industry throughout Central America. New research especially in biological control would benefit the regional industry and stands more chance of being initiated if greater organization support across boundaries can be arranged.

In summary, the consultant recommends that PEP should

1. Give further technical support in the next few months to Danlí to allow them to consolidate their entry into the industry. A minimum of three or four days of technical assistance would be adequate, the appropriate time could be (June) when the new trees propagated in the nursery are planted out in the field. It is important that these plantings are undertaken correctly in the right soils, and that the operators understand what management procedures must be followed to look after the trees and collect the required data.

2. Encourage the formation of an industry association to take responsibility of looking after the interests of its' member growers. This association could be funded by sale of new trees to members and if necessary membership fees.